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CHALLENGES IN THE DEVELOPMENT OF NORTHERN CANADA

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Introduction

When Murray Hawkins approached me about a year and a half ago to take part in this panel I accepted for two reasons. First, I have had a long association with Canada north of 60°, which goes back to 1946. Second, I am a firm believer in the benefits of transdisciplinary activities. As a more or less "pure" biologist raised on the prairies I have had lifelong contacts with "practical" biologists in various agricultural fields. I see my personal challenge as an attempt to interpret the midnorth to those of you without personal experience there in the light of a scientific preparation and experience that differs somewhat from yours. I do so with apologies to the Pringles, Harrises, Guitards and others with northern experience. As a result of those differences I have developed some attitudes and ideas that some of you ma find foreign. People who stay too long in the north are often accused of being "bushed". Perhaps that will be your ultimate judgement of me, but hope that I can at least stimulate a little thought and controversy.

My remarks will apply to Canada north of 60° and south of the tree line. Larry Bliss, formerly of the Department of Botany of this Universi recently dealt with agricultural possibilities north of tree line (Bliss, 1978) and found them to be essentially non-existent. Furthermore, my personal experience has been predominantly in the southern Mackenzie District, although I lived in Whitehorse for three years and have at least a nodding acquaintance with the northern Mackenzie.

I think it worth while to review briefly the major constraints on extending agriculture to the mid north. Similar constraints apply to wil plants and animals. The north is <u>not</u>, as popular wisdom has it, a countr

abounding in big game. Abundance, in the north, is characteristic only of certain kinds of insects - especially those that bit, pierce, suck, or otherwise irritate.

The most fundamental constraint is cosmological -- the accident that gave our earth's axis a tilt of about 23-1/2° from the vertical, thus ensuring that seasonal phenomena are intensified with increasing distance from the equator. As a result, we have long cold winters; short, warm summers; and brief transitional periods, hardly to be dignified by the names spring and fall. We can do nothing to alter that situation.

Meteorological constraints are largely a direct result of seasonality which sets limits to the number of frost-free days, length of the vegetative period (Ta > 5.5°C) and accumulated degree days. Half of the year's total of incoming radiation has fallen by the summer solstice, much of it before crops can even be sown. All of those parameters are influenced by day length, which at least partially offsets the effect of increasing latitude. Thus, minimum requirements for crop production are met (or closely approached) on the average even as far north as the Mackenzie Delta at about 68°. However, the north is a land of extremes, in which averages can be deceiving. Dates of snowmelt along the arctic coast can vary by as much as a month, and, given the generally close fit to the minimum requirements, late springs would obviously be catastrophic for crops. Once again, there is little or nothing that we can do to alter the situation, at least at the macro level. We can, and do, influence microclimates (cf Blaxter), but only at added cost, and, almost by definition, on a small scale.

Geology imposes another set of constraints. First, we are saddled with the northerly position of the plates underlying our continent.

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What is now high latitude has been tropical in the past, and perhaps, in the fullness of geological time, with the universe unfolding as it should that situation will once again prevail. Second, part of the territory under review consists of exposed granitic rocks of the Precambrian Shield on which conventional agriculture is obviously impossible. The western NWT and most of Yukon is mountainous, with slopes too precipitous to cultivate, north-facing slopes that will not support crop plants, or narrow valleys too well protected from incoming solar radiation. With minor exceptions, glaciers covered the land and their advance removed the thin mantle of soil. Lack of time since deglaciation, coupled with meteorological constraints on soil-forming processes, has resulted in poor soil development *in situ*. In particular, most northern soils are desperately low in nitrogen and, usually, phosphorus. Many are also deficient in potash and sulfur. On the other hand, post-glacial lakes trapped sediments carried down by rivers, and fluvial processes are still operating on major rivers. The quality of alluvial soils is reflected in the vigor of riverine forests. Finally, so-called peri-glacial features associated with permafrost are widespread, though intermittent, in the area under consideration. Wherever permafrost occurs the depth of the root zone is severely limited, or, at best, the temperature of the root zone is held close to 0°C. We can do little to overcome these constraints except to maintain, or where possible improve, the quality o the soil.

Biological constraints affect plants, animals, and microorganisms. They have been dealt with eloquently by Sir Kenneth Blaxter. Physiologi processes, including growth, generally proceed more slowly as temperatur fall. Thus, plant and animal growth rates are reduced, decomposition

and return of nutrients to the soil is slowed, and nitrogen fixation is considerably less efficient than at lower latitudes. Sir Kenneth failed to mention that snow may be more serious than cold for wild northern species. Birds migrate from the north because their food is no longer available, not because they cannot stay warm. Those that can find food - in shrubs, trees, and snow-free areas - stay. Even very small birds such as chickadees and redpolls weighing less than 15 grams can cope with cold if food is available. Mammals generally have less difficulty with snow than birds do, but their energy costs are increased.

Wild animals have adapted to short northern summers in a variety of ways. For example, song birds, which frequently renest at the latitude of Edmonton, have no time to do so further north but clutch size tends to be a little larger in the north in compensation. Some shore-birds have devised methods of uncoupling breeding and moulting in order to even out their energy requirements during the short summer. Geese breeding along the arctic coast gear their reproductive output to environmental conditions. Given an early spring they lay maximum clutches, but when spring is delayed the female begins to resorb eggs to maintain her own condition, with the result that production falls linearly with lateness of the season, and in some years it reaches zero. These strategies have obviously been successful in evolutionary time, but the "bust" years would be inconvenient, to say the least, for a poultryman. Of course, artificial environments could remedy the situation, but only at a cost in money and energy.

It is at this stage, however, that as biological scientists we can do something to get around the difficulties. Sir Kenneth dealt with improvements to domesticated stocks of both plants and animals. I wish to enter

a plea that we proceed more rapidly to ensure protection of the genetic resources on which such improvements ultimately depend. Canada has been slow to establish Ecological Reserves in the north.

Mention of high costs leads directly to economics as a further constraint. Not only are costs of land clearing, fertilizers and other inputs high, but internal markets are small and high transportation costs preclude shipping products to outside markets at competitive prices.

In today's world we cannot overlook political constraints. Even as little as 10 years ago politics would have been a minor consideration, but the rise of the Dene Nation, the Council of Yukon Indians and analogous Inuit organizations has altered all that. Potentially arable land, along with almost all other land in the NWT, has been frozen pending settlement of land claims, and there is no indication of when that may occur.

Use of the best lands for agriculture, assuming the freeze is lifted would result in conflicts with the interests of other resource users. Hunting and trapping are still important to the native peoples and to long time residents of European origin. It has been estimated by one source that the meat of game is equivalent to an annual income of $4000 per family, and the sale of furs added $5.7 million to the economy of the NWT in 1978-79, of which probably about $4 million worth came from the District of Mackenzie. Beyond the monetary value, of course, lies a long tradition of living off the land, which is deeply ingrained in the native peoples. Game animals are a crop produced by the land, and we must remember that poor land produces poor crops. We cannot relegate

game production to waste lands without seriously affecting the production of game animals. And, because large predators such as wolves, bears, coyotes and lynx are incompatible with a livestock industry, the necessity to kill off large predators would bring the industry into conflict with conservationists and wilderness devotees.

Similar remarks apply to forest production, which is now a $5 million industry in both Territories combined. Commercial forests are essentially restricted to the alluvial soils along rivers — the very soils that would be most productive under cultivation.

Lack of research is a final constraint. I was familiar with both the Ft. Simpson and Haines Junction Agricultural Research Station in the 1950's, and never begrudged the taxes that I paid in their support. Perhaps this Conference would entertain a resolution urging the Federal Government to get back into the business of northern agricultural research.

Given this list of constraints, then, are there any possibilities for agriculture? First of all, history records that the Roman Catholic missionaries had gardens at settlements along the Mackenzie as far down as Aklavik. At some of the missions, notably Ft. Smith and Ft. Providence, a few cattle were also kept, and a few acres of grain were grown for winter feed. I remember the end of the experiment at Ft. Smith, which came after brucellosis was diagnosed in the herd. However, I wonder how many farmers would be willing to work for the same wages as the brothers in the mission who tended the cows. An attempt to raise cattle near Hay River in the 1960's ended after 3 or 4 years and several convictions for selling unpasteurized milk in the town. I used to see them feeding along the roadside in early May when I began my summer season, and it was a

mystery to me how such bags of bones survived the winter. In the Yukon, too, agriculture blossomed briefly in connection with the Klondike gold rush, but, when the population fell from around 30,000 souls to fewer than 10,000, most of the agricultural activity also ceased.

Market gardens, on the other hand, have been successful at Hay Rive and probably elsewhere. Paradise Gardens has been functioning for about 30 years. A considerable variety of vegetables is produced in the field and exotics such as green peppers, produced under glass, can be had if you are friends with the owner. This operation, which is about 15 miles out of town, has no costs associated with moving the product to market. Townspeople come to the gardens to buy, literally off the vine. Our standard practice for years was to stop on our weekly trip to town, pick up our week's order, and place an order for the following week. That wa the only way to ensure that everything would not be sold out.

Up to this point, I have been talking mainly of what might be calle "conventional" agriculture. I now want to make a few remarks about a possibility that is unconventional in the Canadian scene, namely, ranchi of wild game. Semi-domesticated reindeer have been introduced to parts of Canada on several occasions, but I will confine my remarks to the her in the vicinity of the Mackenzie Delta, which was begun with stock drive over from Alaska in the early 1930's. Whereas the drive itself, under t direction of the late Erling Porsild, was an heroic achievement, I count the experiment in total a failure. Its original purpose was to provide steady income to eskimos who would be trained as herders, but this has never happened. The herd has never reached 10,000 head as far as I can determine (cf. about 500,000 head in Alaska before the crash), and the

economics of the operation must indeed be dismal, although I have seen no figures. As an experiment, it was worth trying. But there is no law that says experiments must always succeed. Those that fail ought to be terminated. Experiments in domestication of muskox have now been going on first in New England and later in Alaska for 25 years. I have not followed these closely, but Dave Klein, who is here from Alaska, will surely have up to date information. Finally, I would like to suggest one species that deserves further investigation, namely, bison or buffalo. Historically, wood bison ranged at least as far north as the Liard River. Currently, the mixed herd of wood and plains bison in Wood Buffalo Park is maintaining itself in spite of chronic infection with tuberculosis and brucellosis, and periodic outbreaks of anthrax. But the exciting development is the history of the herd in the Mackenzie Bison Sanctuary in the Ft. Providence-Deep Bay region. The origin of the herd was 18 disease-free animals of the wood bison type released in 1963. The herd numbered about 650 in March of 1980 (NWT Wildlife Division). Counts made in 1967, 1968, and every years since 1971 show that the instantaneous rate of increase, in the total absence of any form of management save protection from legal hunting, has been 23%. The fit of the counts to an exponential series is unbelievably high for field biological data — $r^2 = 0.997$! Since bison meat is every bit the equivalent of beef, it is surely time for animal scientists to give up their fixation on the common cow and devote some attention to an animal that can make it on its own under northern conditions.

Most of the points I have raised are probably either self-evident, or at least well known, to anyone with a biological bent, pure or applied, and some knowledge of, or feel for, the North. The question, however, is

what should be our policy toward northern agriculture? There appear to be two rather extreme positions. On the one hand, it has been argued that even marginal northern lands ought to be cultivated as a Canadian contribution to solving the world's food problem. In my view that argument borders on the ridiculous. Only control of the number of mouths to be fed can solve that problem. On the other hand, it can be argued that, because agriculture is presently such a small industry in the north (see, for example, Peake & Walker, 1975), arable and grazing lands should receive no special protection or concern. That argument offends my sense of appropriate use of land. Surely we must learn to match land use with land capability.

There is, however, another possibility — encouragement of small-scale agriculture to meet local needs and what W. E. Burton of Palmer, Alaska calls "agroeuthenics". Historically, as noted, small-scale agriculture played an important role in both Territories, and the time may be approaching when that will once again be the case. Populati which mean larger markets, are increasing rapidly (doubling time about 1 years in the NWT); rising costs of liquid fuels are forcing up costs of imported produce; new techniques, such as using waste heat from electric generators, in concert with hydroponics, can remove many of the uncertainties; and, with the increasing trend toward large-scale farming on the prairies, perhaps the last stand of the family farm will be made in the North.

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